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System of management and traceability of logisticitems through new technologies

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Abstract

The article deals with management, controlling and traceability of transport containers through automatic and data capture technologies. The identification and monitoring of roll cages through new technologies, allows the administration and management of container logistics. The main tasks include the traceability and control of the movement of containers and accumulation of transport units within the logistics centers. In this article we would like to share knowledge how to provide visibility, identification and monitoring of roll containers in real condition by selected logistics provider. Our pilot tests are based on the results reached during the test that was realized on a selected area of transport network, the aforementioned logistic provider. The end of the article focuses on the economic assessment of the managing, monitoring and identification of containers in conjunction with needs of the logistics provider.

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Keywords: management; identification; roll container

1. Introduction

Automatic identification and data capture i.e. AIDC system of varying technologies for data collection based on different principles. They are mainly bar code technology, radio-frequency identification, voice identification, OCR technology, identification via infrared, etc. RFID could be called the rising star in this family, in that it seems poised

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to offer many benefits not yet offered by any other technology. Radio frequency identification (RFID) technology is considered as ‘‘the next big thing’’ in management (Wyld, 2006) since the technology enables:

- This technology can provide valuable data for optimizing business processes, as well as to increase the degree of automation and will allow the elimination of bottlenecks(Strassner, &Schoch, 2005).
- This technology will further enable the emergence of new intelligent processes that allow their automatic implementation based on demand.

RFID technology is increasingly starting to become part of our everyday life. The biggest advantage of this technology is undoubtedly its ability to identify, monitor movements of persons of assets in real time. Another advantage is that it does not require line of sight between the RFID tag and an RFID gate. At present, we can say that it is applicable in almost all areas of human life. But its greatest application is in the area of logistics. In this context there are several question of feasibility of the use of identification of goods. The most important aspects that determine the possibility of introducing new technologies into organizational processes. In addition to these important aspect is the objectivity of the introduction of new technologies.

There are many pilot solutions in conjunction with tracking goods, roll containers to measure trailer utilization and to track container locations (Vaculík, Kolarovszki, &Tengler, 2013). At present there are still many businesses that use manual tracking systems for containers. This activity is not cost- and time-consuming. This process moreover does not provide information in real time and thus may not be in peak periods sufficient information for optimal management. One of the potential application of RFID technology. Suitably selected points within the transport network logistics operator to monitor the movement of containers in real time. Through historical data and data from RFID readers can be better management realized containers throughout the logistics network. This technology is able to provide relevant information to reduce the cost of transportation of containers between branches logistics operator, also allows to reduce the rate of loss of containers and ensure relevant information about their utilization and maintenance.

In general, and based on the results of various solutions based on AIDC technology it can be stated that the automated processes are much more reliable than manual ones. The most common AIDC technology is bar code technology, which uses optical scanners to read labels. Most people in the world already has experience with barcodes, especially in the time of smartphones. Faced with them, mainly at stores but also in other activities of your life. Barcodes can be named to mark a small revolution because they allow automated read at one time or several numbers characters in a row, a human vision not. The actual use of this technology will significantly accelerate and improve the accuracy of the identification process. Another important technology is already mentioned RFID technology. This technology again represents a small revolution in terms of identification, and because it allows what other technologies cannot. The whole principle is based on the use of small electronics to communicate via radio-frequency waves.A type of AIDC technologies clearly describes figure 1.

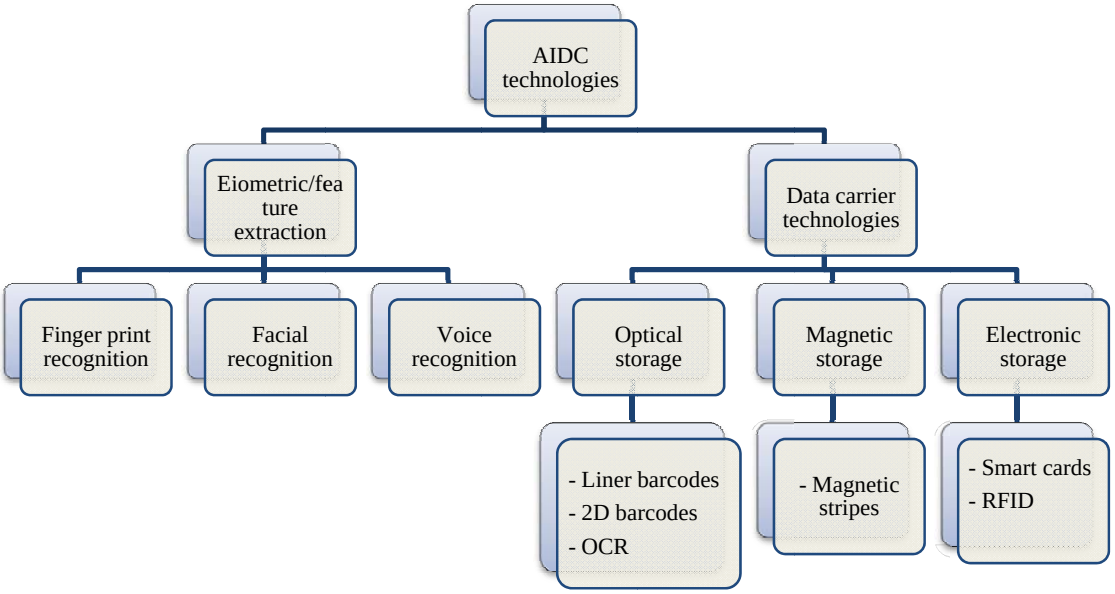

Fig. 1. Type of AIDC technologies

2. RFID technology architecture

The RFID technology belongs to the group of wireless technologies and that they allow communication or identification via radio-frequency waves. The system is formed by two elements. The first RFID tag, which is a small electronic device and the antenna formed by the MCU. The second one is the RFID reader with antennas. To communicate with enterprise systems still use specialized software known as middleware (Asif,&Mandviwalla, 2005).

2.1. RFID tags

The most basic function of RFID tag is transmitting the information stored in its memory. It is usually a clear message identifying the tag. As already mentioned, the tag consists of a microcontroller and antenna. Both of these components are stored in a protective container, which can take various forms, according to the application area. The most standard type is a tag embedded in the so-called smart label. Outside reading information stored in the tag, it can be for specific tag and change or even permanently break your access to memory. Some tags also contain batteries, and this is what differentiates active tags from passive tags.

2.2. RFID Interrogators

The RFID interrogators can be regarded as a structural bridge among the RFID tag and the controller. RFID interrogator has several basic functions (Vaculík, Michálek, &Kolarovszki, 2009):

- Read data stored on the RFID tag.
- Write data to the memory of the RFID tag.
- The relay data to and from the controller.
- Power the tags from the electromagnetic field emitted by the RFID gate (with passive RFID tag).

The complex RFID interrogator also allows other support functions:

- Anti-collision measures when reading multiple tags simultaneously.
- Authentication measures to prevent unauthorized access.
- Data encryption to protect the integrity.

2.3. RFID middleware

The RFID middleware can be considered as a communication intermediary between RFID hardware and enterprise systems. Beyond this basic function, this middleware allows logically tend to filter information sent to him (Kolarovszki, &Vaculík, 2013).The middleware could provide the following:

- Simple configuration and follow-up and monitoring.
- Remote management and access to RFID middleware.
- Filtering, routing and aggregation of data.
- Connectivity with enterprise systems.

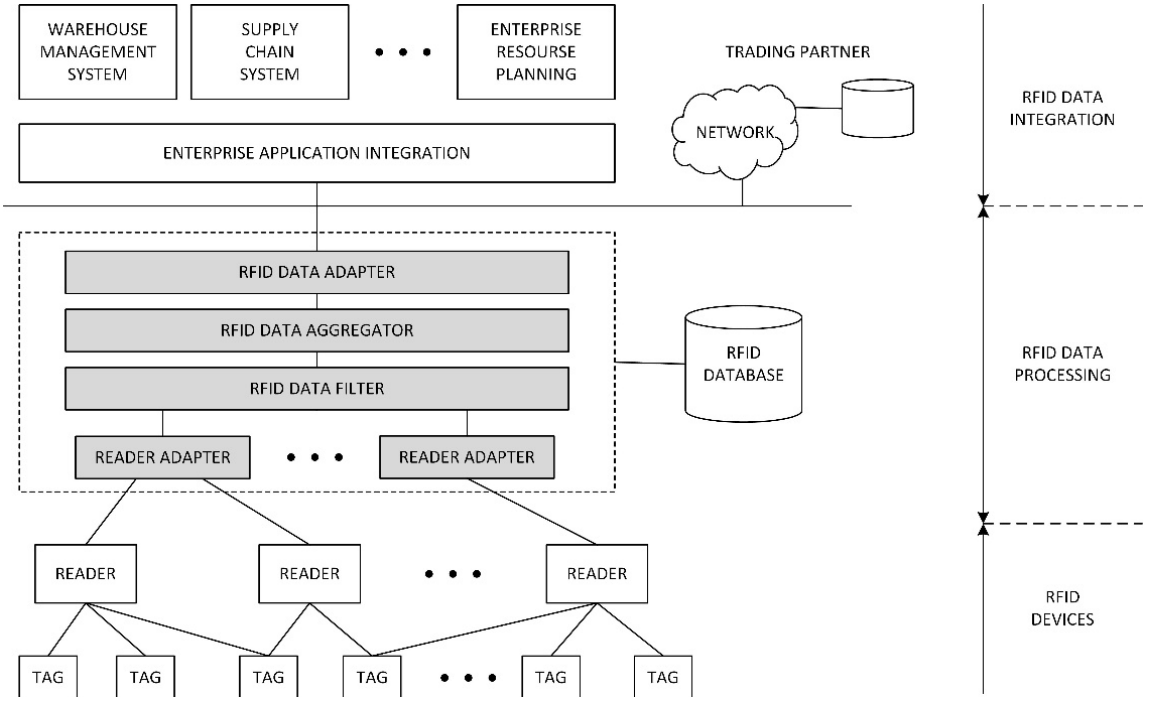

Fig. 2. Positioning RFID middleware in an RFID system (Hunt, Puglia & Puglia, 2007)

The RFID technology can revolutionize the supply chain and its management. The implementation of RFID technology in the relevant paragraphs of the supply chain would allow their management and fulfillment of the basic functions of logistics. Therefore deliver the goods in the right quantity, at the right place at the right time. RFID technology itself, although this fails, but the information it has received so. It can say that the technology to synchronize information and physical flows (Nurminen, 2006; Kebo, Staša, Beneš, &Švub, 2013).

2.4. Problems with orientation and location of RFID tag

In all applications, it is essentialand of great importance to unite and align the antenna with the antenna system identifier reader. Same alignment orientation identifier in phase with the direct model antenna gives optimal

outcomes. There is an unwritten rule that the identifier can be disoriented by an angle of 15 ° in any direction with a slight to negligible performance degradation.Correct adjustment of the system may allow an even greater tolerance. The tolerance for the disorientation system can read the label in a different orientation and angle of presentation changes depending on their trajectory across reading (Kolarovszki, 2014).

3. System for managing and monitoring of roll containers

The main assumption in connection with automatic identification and tracking of logistics transport units (postal containers) by passive RFID tags, was to identify how the metal structure of the transport unit may affect on readability of RFID tags and how the value of RSSI will change. Projects focuses on automatic identification and data capture in conjunction with asset monitoring has one main problem. The problem is usually to clarify and streamline the relevant asset management. A further requirement is to ensure that the desired number of transport units was always available in the selected time and in the right place(Kebo, Staša, Beneš&Švub, 2013). All these aspects are important not only for mass submitter but also for the postal operator. The mass submitters focus on pre-processing of consignments in transportation units within the premises of the establishment. On the other hand, the containerization at the postal operator takes place within the different levels of the postal transport network. (Vaculík, Kolarovszki&Tengler, 2012). Asset management by monitoring containers using new technology aims to prevent unplanned collecting these types of transport units. On the other hand, if we know where the containers are we know it purposefully aim to significantly improve the processing and sorting shipments and increasing the efficiency of postal operations (Kendra, Lalinská, &Čamaj, 2012). Another aspect in the identification of containers and container logistics management is economy side. Container losses and costs related to the purchase of new containers are several thousand euros per one container (Buková, Brumerčíková, &Kolarovszki, 2014). Fundamental role in the identification and tracking of containers is their traceability and monitoring (controlling) the entire system remotely. Another essential part is necessity for the postal operator to have at selected time and in a sufficient number of their transport units at required place. This avoids time losses in the processing of shipments and also the problems associated with accumulation of containers for mass submitters as well as physical loss of containers (Kebo, Staša, Beneš, &Švub, 2013; Vaculík, Kolarovszki, &Tengler, 2012). The first step on containers dispatch is scanning of containers to their destination delivery. Unless the container passes through the right gate respectively expeditious place, then the consignments placed at the container are loaded into the vehicle. However, if the shipping space to be different, the system will provide an error message and staff must make a correction in conjunction with position of expedition place. The entire asset management solution should enable traceability and full control in real time. It would be also possible to pair containers with that particular consignments (Kolář, &Rodrigue, 2014; Kolarovszki, 2014).

Implementing this system offers unique values. Examples of benefits (Kolarovszki, 2010):

- improve the efficiency of processing shipments
- optimize container logistics
- prevent the accumulation of containers
- prevents loss of containers
- improve traceability of consignments
- reduce the cost of repairs and maintenance

4. Pilot for management, controlling and traceability

We have made a real application, which consists with web application that is shown in figure 4. Selected processing centers and nodes of postal operator were equipped with the aforementioned device. Individual readers are connected to the database server via the mobile Internet. For managing and filtering of data was used middleware, which was connected to a central server. Given the requirement was necessary to create a web application that intervened data in real time. With this application the postal operator was able to check the position of the containers within selected processing centers.

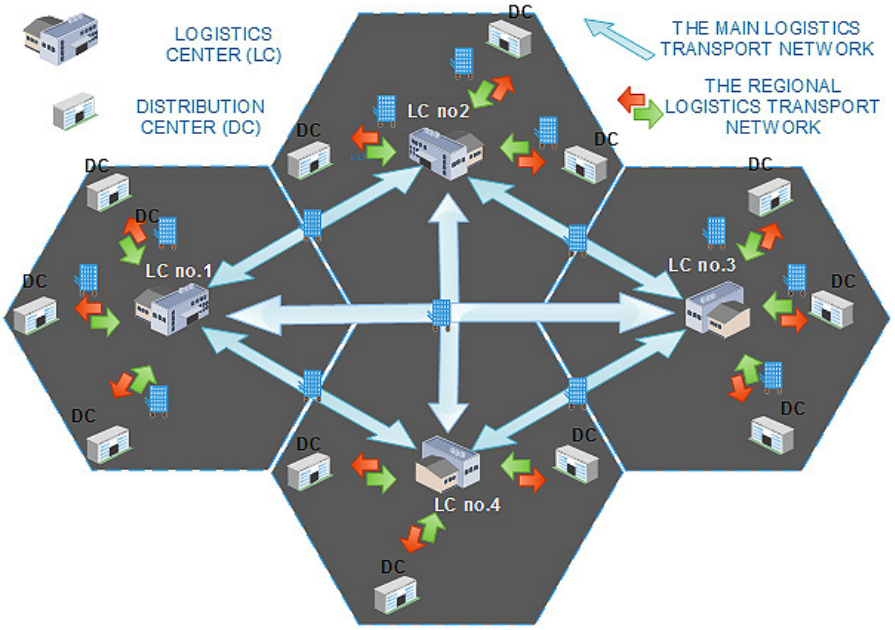

Fig. 3. Transportation of logistics units realized through two level logistics transport network

We have focused on selected part of logistic network and chosen logistics and distribution centers that is described at the Figure 3:

- MLTN (The main logistics network) – represents the portion of the logistic transport network that connects logistics centers in terms of each other.
- RLTN (The regional logistics transport network) – represents the portion of the logistic transport network that connects logistics centers with distribution centers in their own circuit logistics center, i.e. in its own cluster.

The process of receiving and processing logistic units is realized in the following organizational units of logistic network:

- Logistics center – is a logistics organization unit of the highest level that ensure processing and expedition logistics units acquired within its own circuit respectively cluster.
- Distribution center – is a logistics organizational unit of intermediate level that ensure receiving, processing and expedition of logistics units.

Within a Web application, we were able to identify and measure the time that the container spent at the selected center. It was also possible to monitor the processing time within the selected center as well as the time between logistics and distribution centers.

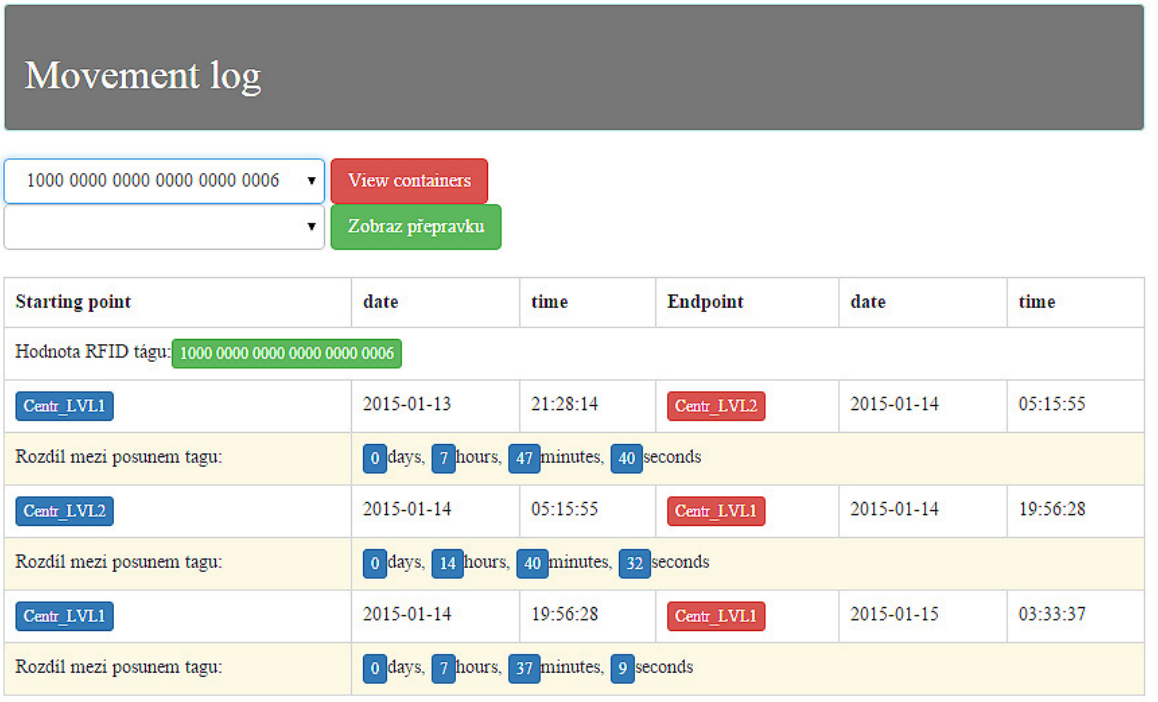

Fig. 4. Web application of logistic containersprocessing

Table 1. Result of measurement "1 cycle".

Between LC and own DCs	Container 1	Container 2	Container 3	Container 4	Container 5	Container 6
Time spent in the transport process (1 cycle)	8:12:00	6:14:00	0:46:00	3:41:00	3:42:00	8:12:00
Time spent in branches logistics operator (1 cycle)	15:48:00	17:46:00	23:14:00	20:19:00	20:18:00	15:48:00
The number of read via RFID readers	5	4	2	4	4	4

After installation of all modules in selected logistics and distribution centers of logistic provider, we placed RFID tags on all roll containers in selected mentioned centers. For several days the system record entries containers through our system. After our pilot measurements we were able to classify and determine the results and also views. Passive UHF tags placed at the postal containers were read every time so we obtained 100% of readability.

5. Conclusion

Based on our measurements and pilot testing, we determined for the postal operator conditions for the implementation of the technology in relation to monitoring and identification of containers. Looking at the results, it is clear that the readability of RFID tags was 100%. Important aspect in container logistics system is a software platform and processing of data and creating reports. We specify several problems at selected logistics centers and our system provided realistic view for postal operator in conjunction with monitoring and identification of containers. This research represents another step towards the identification and visibility of the entire logistics chain and then connection to the concept internet of things (IoT). In the implementation of RFID technology should take

into account its advantages and disadvantages. The main advantage is the traceability of roll containers across the entire network.

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